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ABSTRACT

The purpose of this study is to determine whether non-musically trained persons can make pitch discriminations as well as those with musical training. Four musically trained and four non-musically trained adults listened to an audio recording of pitches and judged whether the second pitch was higher or lower than the first. The results indicate that scores earned by non-musicians were quite similar to scores obtained by the persons with musical training. There is no appreciable difference between the non-music and music subjects on either the range of errors or point of subjective equality. The implications of the research are that regular non-musically trained teachers should be able to provide adequate monitoring and feedback for the students' singing performances. (Author/DE)

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TITLE: PITCH DISCRIMINATION OF PERSONS WITH AND WITHOUT MUSICAL TRAINING

AUTHOR: Laurel Eu, Richard Hoskin, and Richard Piper

ABSTRACT

The purpose of this study was to determine whether non-musically trained persons can make pitch discriminations as well as those with musical training. A sample of musicians and non-musicians was given a pitch discrimination test. It was determined that there is no difference between the groups in ability to perform the task. This paper describes test construction procedures, experimental procedure, results, and conclusions.

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PITCH DISCRIMINATION OF PERSONS WITH AND WITHOUT MUSICAL TRAINING

Laurel Eu, Richard Hoskin, and Richard Piper

Accurate singing is one goal of the SWRL Music Program. For the beginning singer, attainment of this goal depends partly on the teacher's ability to discriminate pitch differences and give relevant feedback. In this discrimination task, the teacher must compare the pitch of the child's singing response to the pitch of the stimulus which, in the SWRL program, is usually a recorded adult singing voice and/or the teacher's own singing voice. If the teacher can discriminate at an acceptable level of acuity, he or she is able to provide adequate monitoring and feedback for the student's singing performance.

An exploratory study was conducted to determine the pitch discrimination ability of non-musically trained adults whose music backgrounds were reasonably comparable to that of regular classroom teachers. The performance of this group was then compared to the performance of the SWRL music staff who has had a considerable amount of training in both music theory and instrumental performance.

INSTRUMENTATION

Due to the difficulty involved in having a singer produce a tone that is off-pitch by a predictable percentage, it was decided to have the singer sing both the comparison (Co) and the standard (St) on the same pitch and to alter the speed of the recorder during the recording by a predetermined amount.

The choice of a recorder to be used for this service was determined by the types of motors used to drive the capstans in current designs.

Motors which synchronise to the alternating line frequency would require a high power variable frequency power source that could be varied by a factor of plus or minus ten percent.

An alternative type of recorder that was available was the cassette recorder Ampex Micro 20. This device uses a direct current motor whose speed is directly proportional to the voltage applied across its terminals. A variable regulated voltage supply is used to drive the motor. A potentiometer in the regulator circuit is used to establish the desired speed.

By disconnecting the internal potentiometer and substituting a remotely located wire wound potentiometer having a large dial, speed could be varied easily in a predictable manner. Calibration of the dial was achieved by playing a standard frequency cassette (TEAC MTT-116L) while the output of the recorder was being monitored by a digital frequency meter. With a test frequency of ten thousand Hertz being picked up by the recorder and the Hewlett-Packard 5221B indicating a count of ten thousand, the standard speed calibrating point was marked. The dial was then varied in increments in both directions from the standard mark while noting the count on the frequency meter. For example, a point on the dial which produced a count of eleven thousand would be marked as plus ten. A count of nine thousand would be marked as minus ten percent. Points in between were established in the same way.

During the recording, if the pitch were to appear lower than standard on playback, the dial would be turned to the appropriate plus marking. The opposite condition was controlled in the same way.

The same recorder that produced the recordings was used in applying the test to the participants. This useage prevented any additional variables being applied inadvertently.

STAGE I

PROCEDURES

In the stage I procedure, participants heard items consisting of pairs of sung pitches. The first pitch was the standard pitch and the second pitch was the comparision pitch which deviated from the standard in alternating descending and ascending series. Deviations ranged from 10% higher than the cps value of the standard to 10% lower than the cps value of the standard. The range of deviations (±10%) included a maximum of one stop to accommodate participants with the least auditory acuity.

The descending series consisted of varying the comparison pitches in sequence, from the largest deviations higher than the standard to the largest deviations lower than the standard. The ascending series started from the largest deviations lower than the standard to the largest deviations higher than the standard.

Three pitches, c', g', and d', were used for the standard pitch. The items were divided according to pitch level into three 84-item subtests. Thus, each subtest included four alternating descending and ascending series of pitch pairs, with the Co deviating from one of the St's in a sequence of either +10% to -10% cps or -10% to +10% cps of the standard pitch.

The stage I test was individually administered to nine SWRL staff members. Three staff members were assigned to each subtest. Each participant was instructed to listen to each pair of items and judge whether the second pitch was higher than, the same as, or lower than the first pitch. The participant was told to say "I don't know" or "I'm not sure" if such was the case. The examiner recorded the responses on a score sheet.

ANALYSIS

Through psychophysical experimentation, several indices have been developed to describe sensory discrimination data. These are 1) the just-noticeable difference limen; i.e., the least amount of difference that was reported correctly by a participant in 50% of the trials, 2) the interval of uncertainty, or the stimulus area between the threshold categories of greater (or higher) than and less (or lower) than, 3) the point of subjective equality, or the comparison pitch most likely to appear equal to the standard, or where plus and minus judgments balance, and 4) the constant error; the tendency of the subject to report as equal those comparison pitches lower than the standard or higher than the standard pitch.

The DL values were obtained by first locating the threshold values for "higher than" judgments and "lower than" judgments. These threshold or T values are found by considering the first response shift from "higher than" responses to "non-higher than" responses T(+) and the first response shift from "lower than" responses to "non-lower than" responses T(-). The T values are then located in the midpoint of the step intervals where the two shifts occur.

After averaging the T(+) and T(-) values over the two descending and two ascending series, the range of responses were consequently divided into three parts: an upper part where "higher than" responses predominate, a lower part where "lower than" responses predominate, and a middle part, where neither "higher than" nor "lower than" responses predominate, and which usually includes a majority of "the same as" or "not sure" responses. This portion is called the interval of uncertainty (IU), half of which is the DL. The midpoint of the IU is the point of subjective equality, (PSE) that is, where the second comparison pitch is most likely to appear equal to the standard. The PSE is rarely equal to the St. There is usually a constant error which can be found by subtracting the St from the value of the point of subjective equality. The constant error indicates whether the participants are more likely to perceive comparison pitches lower than the standard as equal or comparison pitches higher than the standard as equal.

RESULTS AND DISCUSSION

The results are presented below in Table I. Inspection of Table I revealed several trends. Discrimination of pitches higher than the standard was generally better than discrimination of pitches lower than the standard. Thus, the constant error was usually negative showing that the participants tended to report as equal those pitches that were lower than the standard. The participants did very well; the range of error was about 4% above and below the standard. There were no large differences in discrimination error levels as a function of standard pitch levels.

TABLE I

RESULTS OF PITCH DISCRIMINATION TEST: STAGE I

n = 9

		SERIES I St=262			SERIES II St=392			SERIES III St=587		
		S1	S 2	S3	S4	S 5	S6	S 7	S8	S 9
$\bar{T}(+)$*	%	.70	2.48	1.09	.76	.25	.13	1.79	4.09	1.53
	cps	263.87	268.50	264.88	395.00	393.00	392.50	597.50	611.00	596.00
$\bar{T}(-)$	%	4.25	1.96	2.19	3.83	2.81	2.81	1.92	.17	2.89
	cps	250.87	256.87	265.25	377.00	381.00	381.00	575.75	588.00	570.00
IU	%	4.96	4.44	3.29	4.59	3.06	2.93	3.70	3.92	4.42
	cps	13.00	11.62	8.62	18.00	12.00	11.50	21.75	23.00	26.00
DL	%	2.48	2.22	1.65	2.29	1.53	1.47	1.85	1.96	2.21
	cps	6.50	5.81	4.31	9.00	6.00	5.75	10.88	11.5	13.00
PSE	%	1.76	.26	.55	1.53	1.27	1.34	.06	2.13	.68
	cps	257.37	262.57	260.56	386.00	387.00	386.75	586.625	599.5	583.00
CE	%	1.76	.26	.55	1.50	1.27	1.34	.06	2.13	.68
	cps	-4.63	.68	-1.44	-6.00	-5.00	-5.25	-.38	12.50	-4.00

*$\bar{T}(+)$ = average of intervals where participants responses change from "higher than" to "equal," "not sure," or "lower than."
$\bar{T}(-)$ = average of intervals where participants responses change from "lower than" to "equal," "not sure," or "higher than."
IU = interval of uncertainty
DL = difference liment
PSE = point of subjective equality
CE = constant error

Quantitative data and informal reactions by the SWRL staff implied several things for the construction of the stage II test. First, the range of error did not exceed 6% cps above or below any standard pitch. Thus, it was felt that deviations including ±6% cps would adequately cover the transition zone. Furthermore, the SWRL staff expressed greater boredom and seemed to be the most easily distracted on items which included those deviations larger than ±6% cps of St. Secondly, although there seemed to be a slight trend for better discrimination for deviations higher than the standard when the St was 392 cps or g', no large differences in DL, IU, PSE, or CE were apparent between the three standard pitch levels. Thus, it seemed appropriate to use only one standard pitch, g', for the stage II test. Selection was also based on the fact that many of the music program songs are centered around g'. Finally, the option of "I don't know" was eliminated due to feedback received from participants who took the stage I test.

STAGE II

PROCEDURES

Like the stage I test, the items for stage II consisted of 13 pairs of St and Co tones. Each pair was presented five times in random order, making a 65-item test.

The test was administered in group mode to eight SWRL staff members, four of whom were on the music staff. The examinees were asked to listen to the audio recording and record their answers after hearing each pair of pitches. The task was to judge whether the second pitch was higher, the same as, or lower than the first.

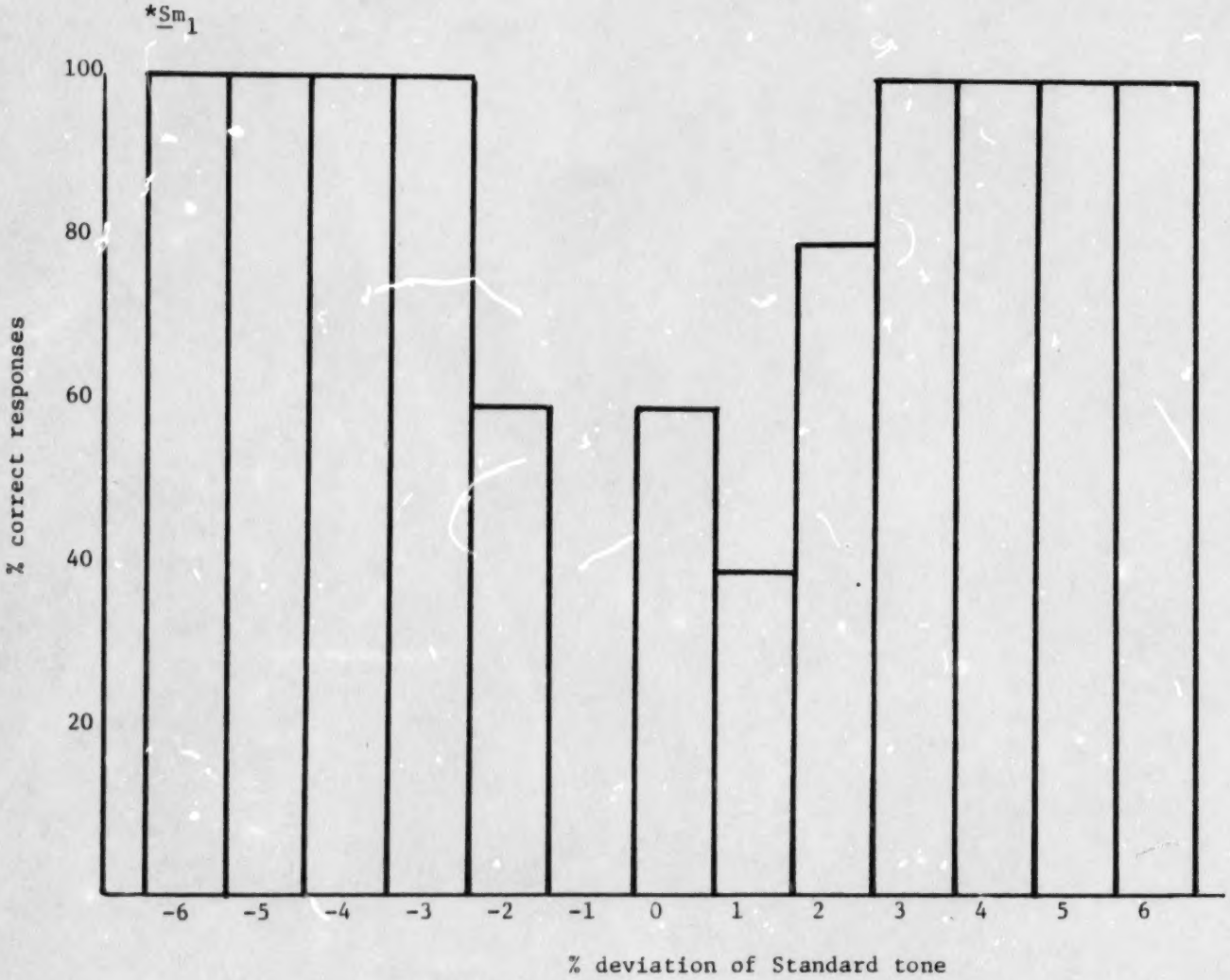
Since each pair was presented only a small number of times, the testing time was reduced. However, this also meant that the data, when plotted, would not produce a smooth curve from which estimates of threshold values and point of subjective equality could be easily interpolated.

RESULTS AND DISCUSSION

Given the small number of presentations of each comparison pitch, only rough estimates of threshold indices could be obtained. The data were thus inspected for 1) the range of comparison pitches at which errors occurred, and 2) the estimate of point of subjective equality. Data for each participant are summarized in Figures 1-8.

Scores earned by non-music staff members were quite similar to the scores obtained by the music staff. The range of errors for the non-music staff personnel was from -3% to +2% cps, while the music staff made errors from -2% to +2% cps. The point of subjective equality was very near to the standard tone in all cases; for all participants the CE was almost negligible.

There were no appreciable differences between the non-music and music staff members on either the range of errors or the point of subjective equality. Scores indicated that on the average, the non-musically trained person can discriminate pitch differences almost as well as the musically trained person. This conclusion is probably representative of findings that would be obtained with a group of teachers. Thus, it is felt that most teachers can discriminate differences in pitches adequately for the monitoring task required of them in the SWRL Kindergarten Music Program.



*Sm = music staff member

Figure 1. Percent correct responses for pitch discrimination test frequency method.

Figure 2. Percent correct responses for pitch discrimination test frequency method.

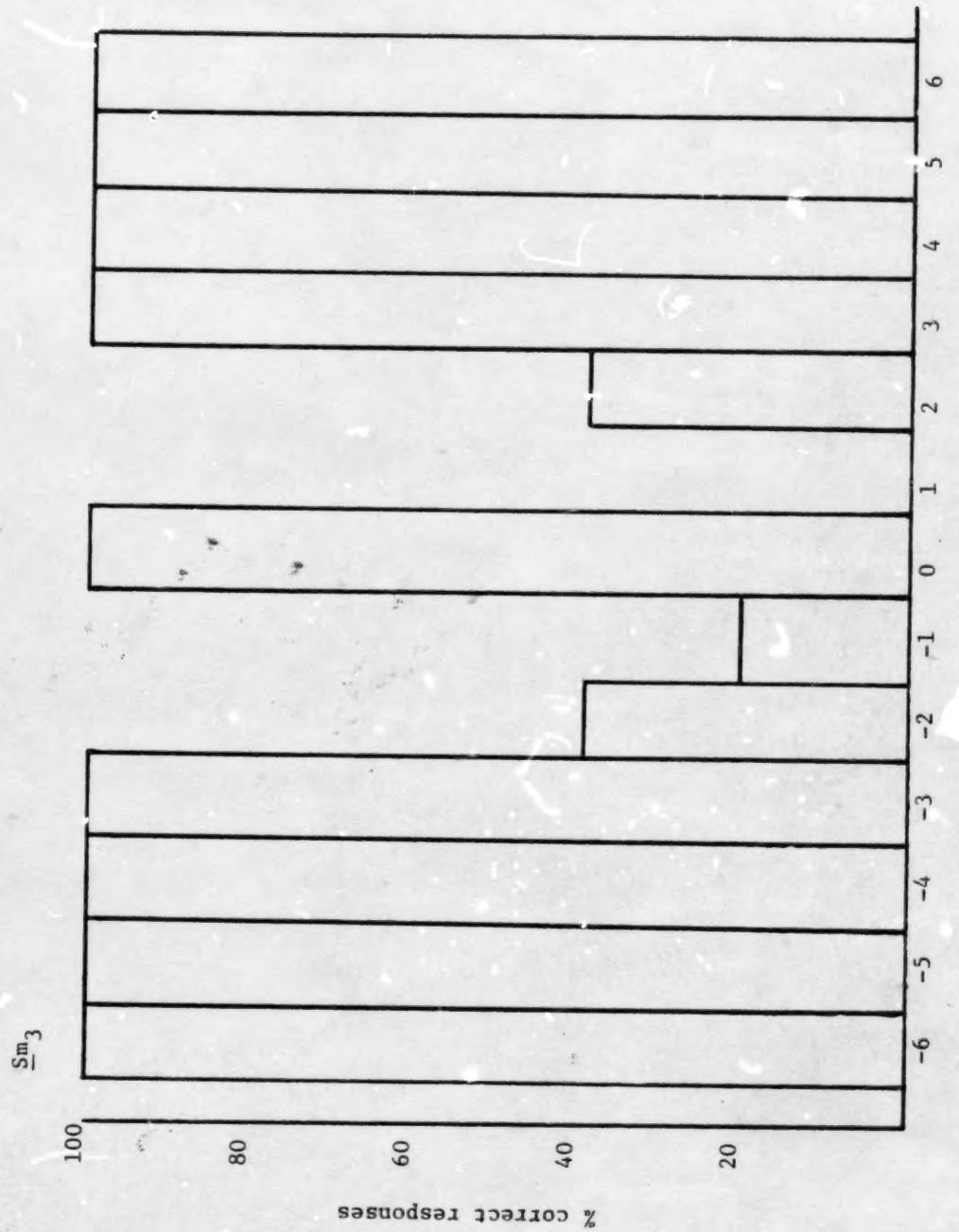


Figure 3. Percent correct responses on pitch discrimination test frequency method.

41

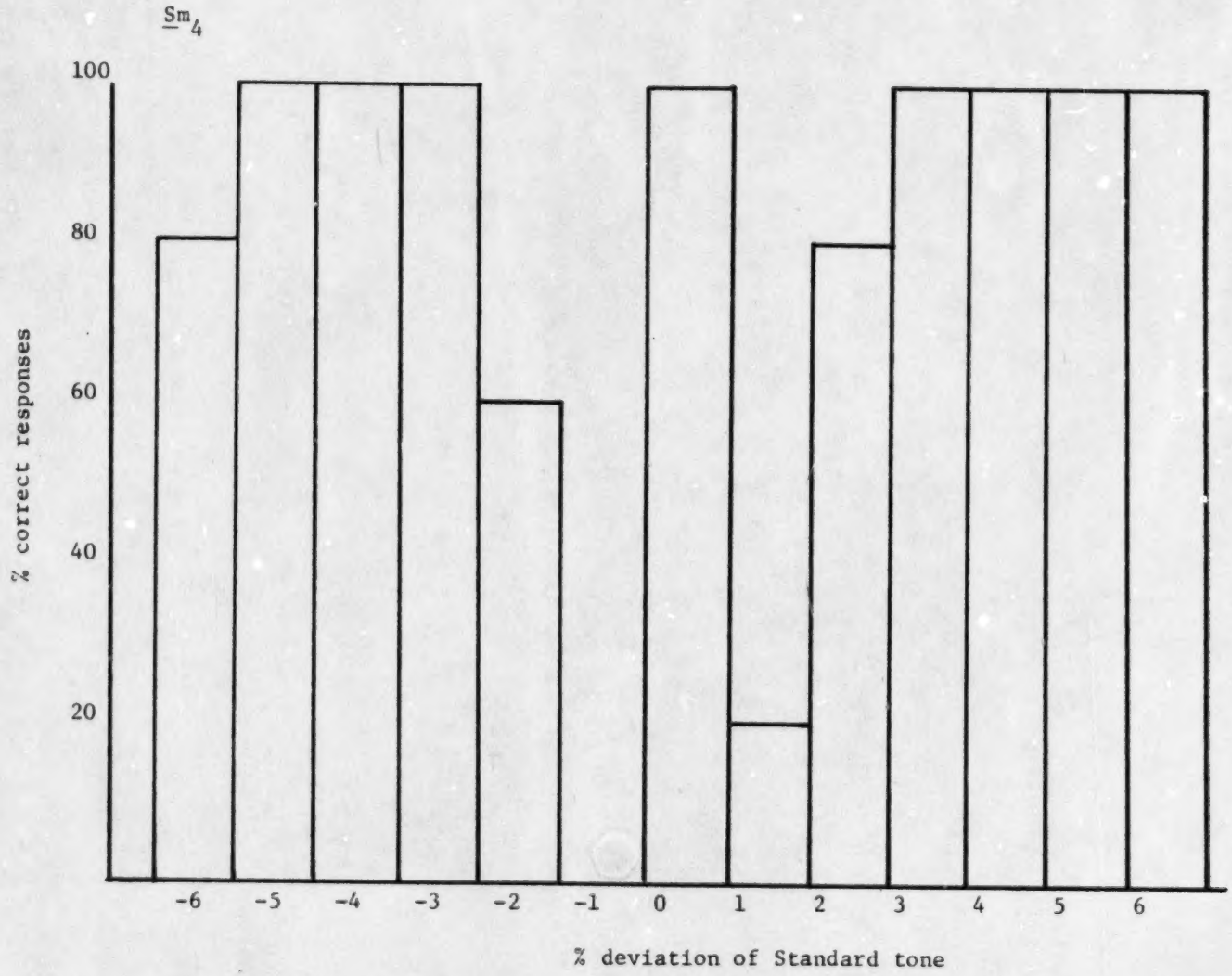
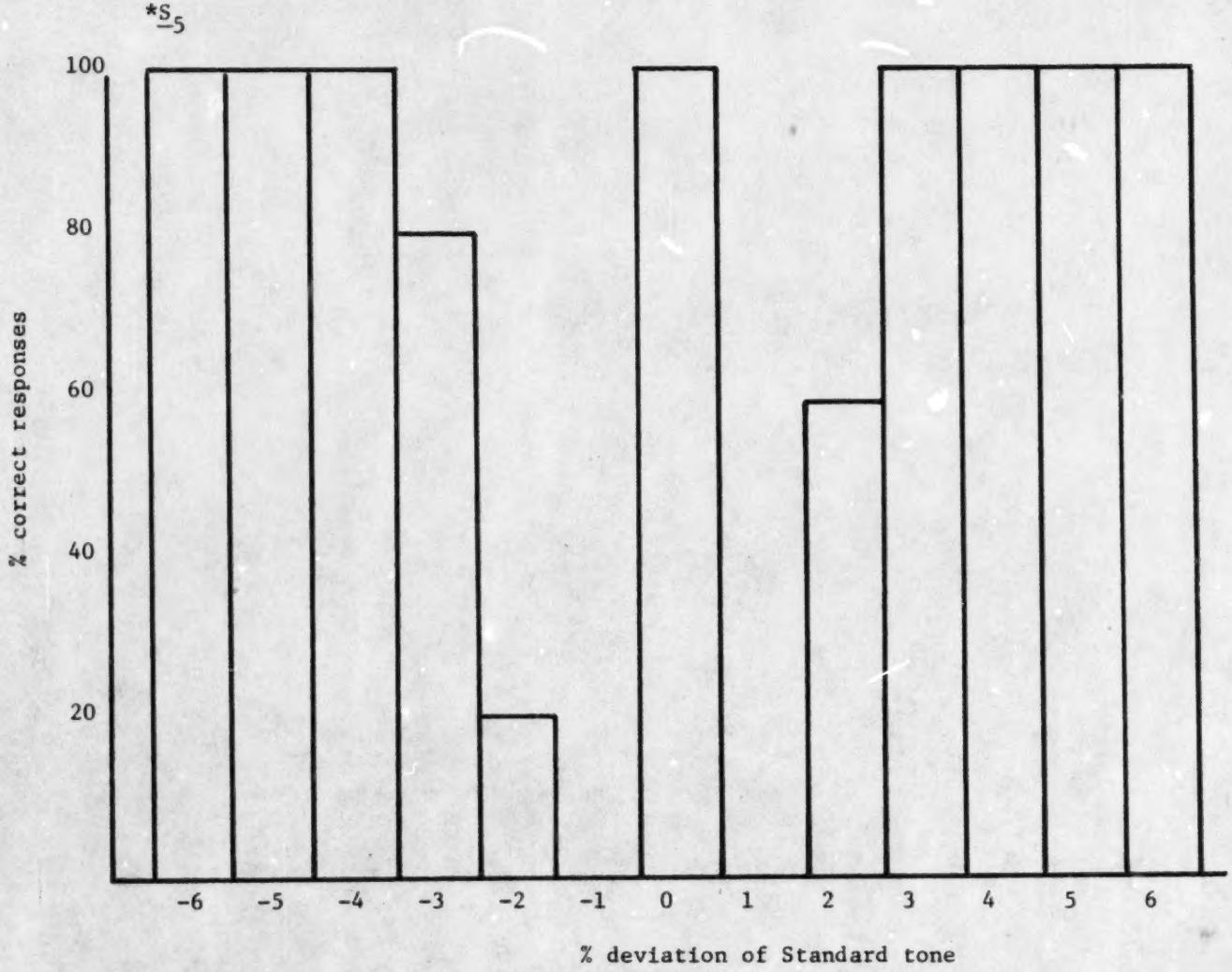


Figure 4. Percent correct responses for pitch discrimination test frequency method.



*S = non-music staff member

Figure 5. Percent correct responses for pitch discrimination test frequency method.

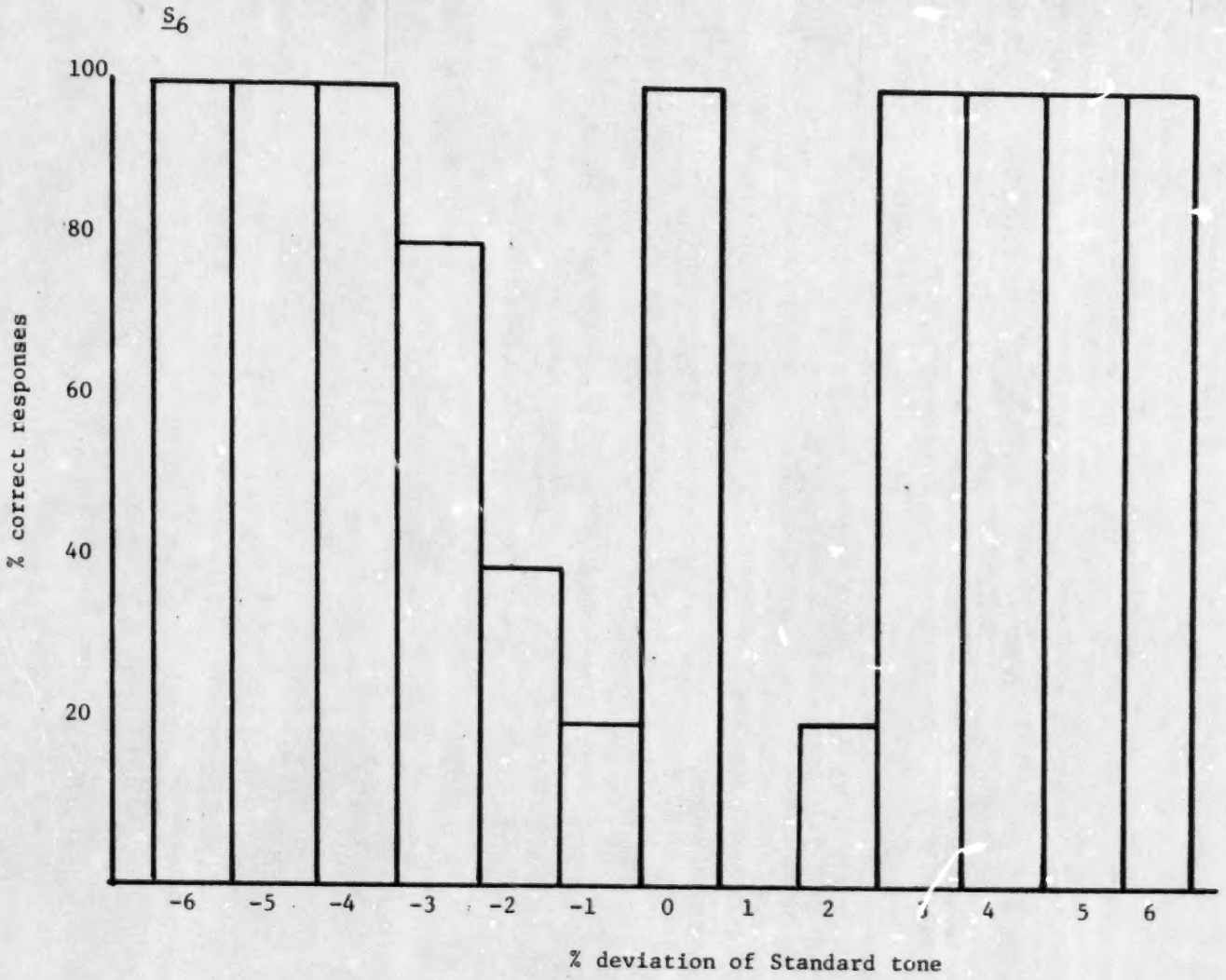


Figure 6. Percent correct responses for pitch discrimination test frequency method.

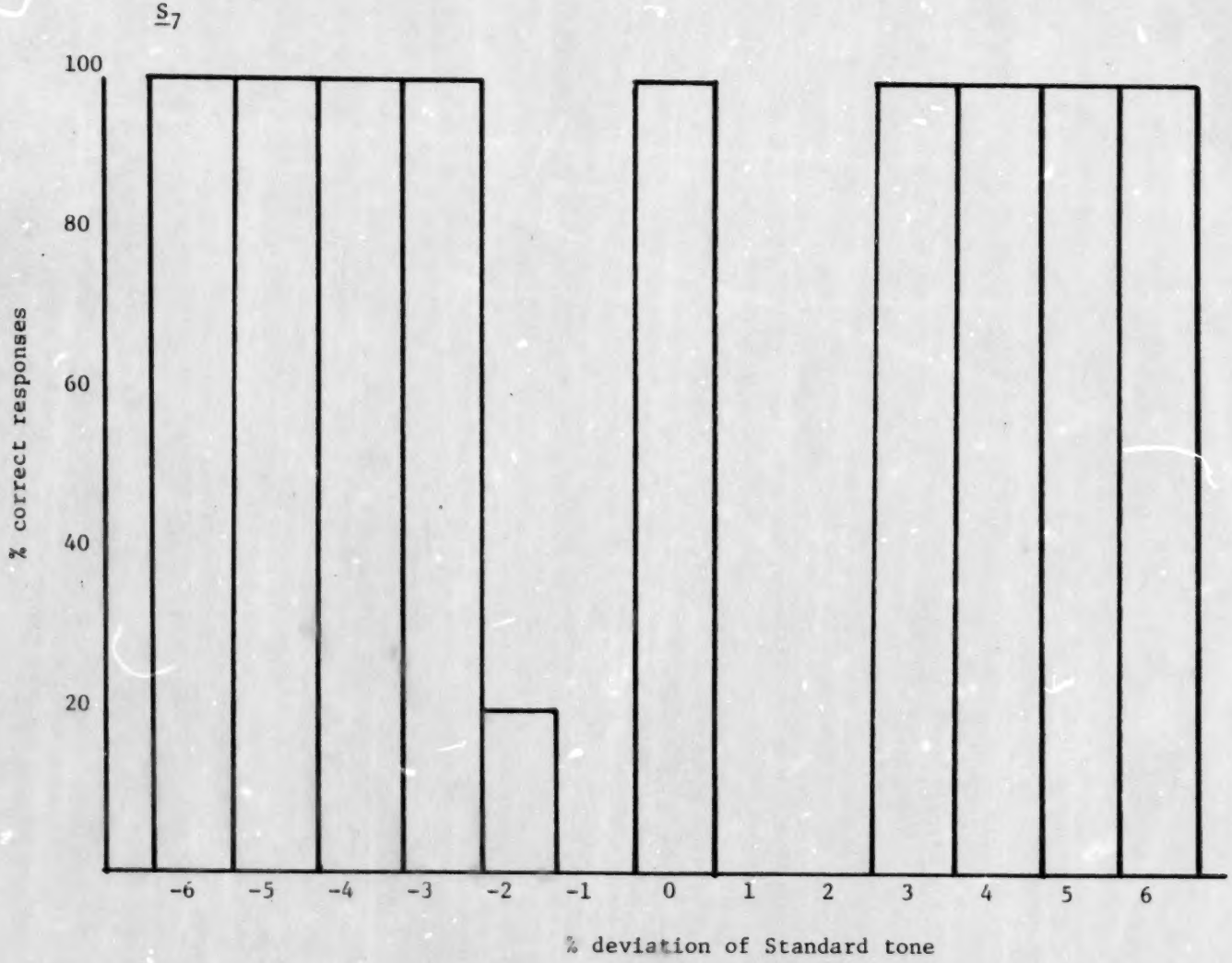


Figure 7. Percent correct responses for pitch discrimination test frequency method.

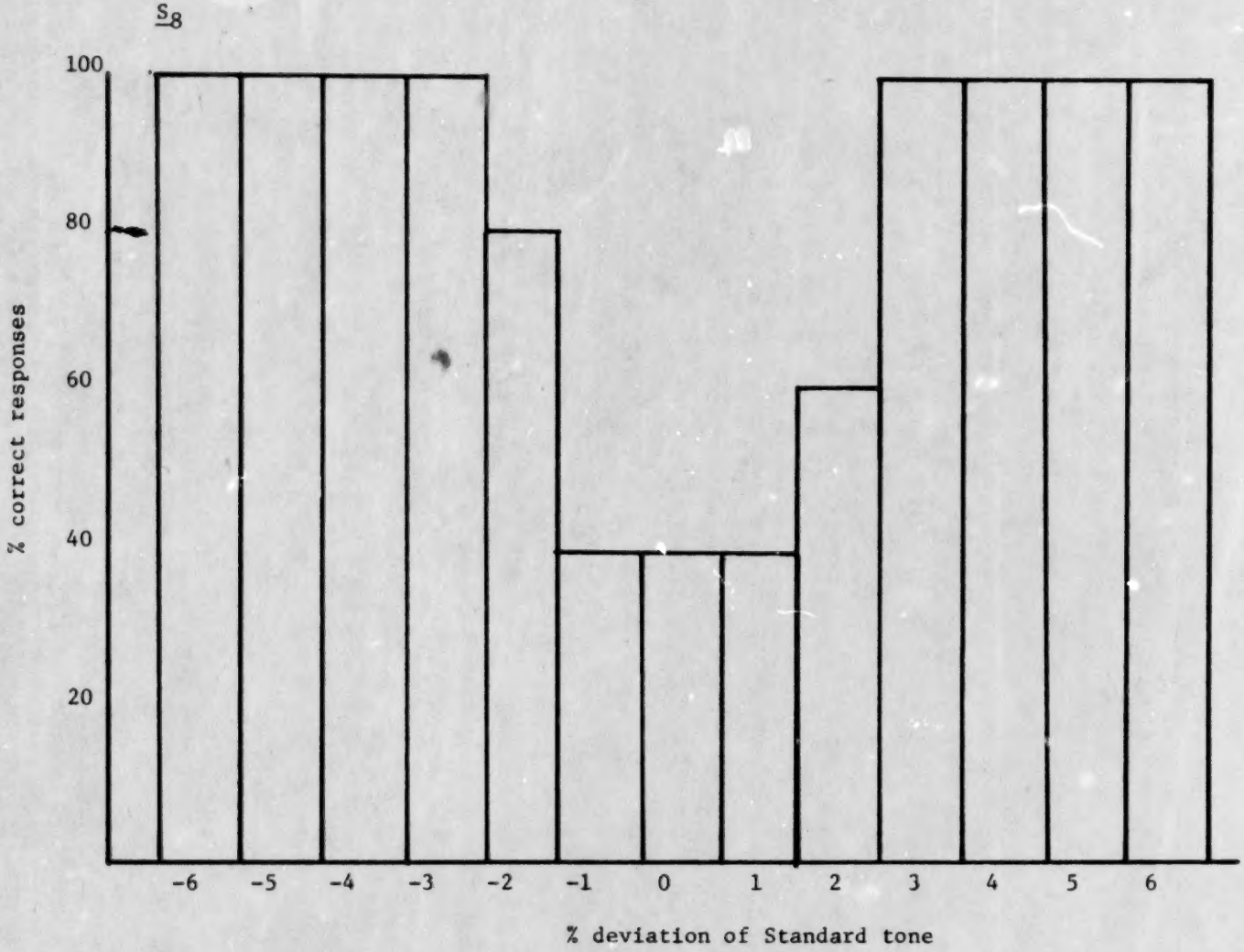


Figure 8. Percent correct responses for pitch discrimination test frequency method.